Inquiry Investigation 5-A

Skill Check

Initiating and Planning

✓ Performing and Recording

✓ Analyzing and Interpreting

✓ Communicating

The Bohr-Rutherford Model of the Atom

The Bohr-Rutherford model is commonly used by scientists to represent the atoms of elements. In this investigation, you will make Bohr-Rutherford models for 20 elements.

Question

How can the atomic structure of an element be represented using the Bohr-Rutherford model?

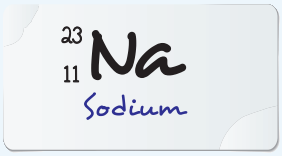
Materials

- 20 blank index cards

Mass Numbers

Atom	Mass Number
H	1
He	4
Li	7
Be	9
B	11
C	12
N	14
O	16
F	19
Ne	20
Na	23
Mg	24
Al	27
Si	28
P	31
S	32
Cl	35
Ar	40
K	39
Ca	40

Procedure



1. Your teacher will give you 20 index cards. On the blank side of each card, write the name, symbol, atomic number, and mass number of one of the 20 element isotopes listed in the table on the left. Note that the atoms in the table are listed according to increasing atomic number, from 1 (H) to 20 (Ca). Use standard atomic notation to represent each atom, as shown for sodium.
2. On the other side of each index card, draw a Bohr-Rutherford model for the atom of the element. Refer to the instructions for drawing Bohr-Rutherford models on page 190.
3. Complete the cards for all 20 atoms in the same way.

Analyze and Interpret

1. As a general rule, how much larger is the mass number than the atomic number?
2. Which elements in the table follow the general rule exactly? Which elements follow the general rule approximately?

Conclude and Communicate

3. Which atoms in the table have no neutrons?
4. Which atoms have an outer energy level of electrons that is full?
5. Which atoms have an outer energy level of electrons that is one electron short of being full?

Extend Your Inquiry and Research Skills

6. **Research** Identify the elements listed in the table that have additional isotopes. Choose two of these elements and draw Bohr-Rutherford models of their isotopes.

Inquiry Investigation 5-B

Physical Properties of Metals and Non-metals

In this investigation, you will study four elements and classify each as a metal or a non-metal, based on its physical properties.

Skill Check

Initiating and Planning

✓ **Performing and Recording**

✓ **Analyzing and Interpreting**

✓ **Communicating**

Safety Precautions

- Handle all materials with care.
- Wear safety goggles and a lab apron.

Materials

- carbon (charcoal)
- sulfur
- aluminum
- magnesium
- mallet
- conductivity tester

Question

How can an element be classified as a metal or a non-metal?

Procedure

1. Design a table like the one below to record your observations. Give your table a title.

	Lustre	Conductivity	Malleability
Carbon			
Sulfur			
Aluminum			
Magnesium			

2. Record the lustre of each element. You can indicate relative shininess in your table using + and – signs.
3. Malleability is the ability to be hammered without cracking. Determine the malleability of each element using the mallet.
4. Test each element for conductivity using the conductivity tester.
5. Clean up your work area. Return all equipment, and dispose of all waste materials according to your teacher's instructions.

Analyze and Interpret

1. Group together the elements with similar properties. Which elements always appeared to have similar properties?

Conclude and Communicate

2. Identify the group of elements that had the properties of metals. What properties appear to be common to metals?
3. Identify the non-metal elements. What properties are common to these elements?

Extend Your Inquiry and Research Skills

4. **Research** Conduct research on one of the metals you studied in this investigation. Identify common uses of this metal that are based on its physical properties.

Inquiry Investigation 5-C

Skill Check

Initiating and Planning

✓ Performing and Recording

✓ Analyzing and Interpreting

✓ Communicating

Reactivity Trends in the Periodic Table

Periodic trends include both physical and chemical properties of elements. In this investigation, find out if (and how) the reactivity of metals relates to their position on the periodic table.

Safety Precautions

- Wear safety goggles, safety gloves, and a lab apron.
- Be very careful when working with the acid solution. Acid can burn skin. If you spill any of the acid solution on your hands, rinse it off immediately with cold water and inform your teacher.
- Clean up any spills on your work area, and inform your teacher immediately.
- Do not handle the calcium with your bare hands.

Materials

- water
- 3 test tubes
- test-tube rack
- aluminum
- calcium
- magnesium
- 1 mol/L acid solution (HCl)

Science Skills

Go to **Science Skills Toolkit 7** for information about creating data tables.

Question

Is there a relationship between the reactivity of a metal and its position in the periodic table?

Procedure

1. Design a table to record your observations.
2. Put 10 mL of water into each of the three test tubes. Add one metal to each test tube. Observe any changes and record the relative reactivity of each metal.
3. When the reactions stop, dispose of the water as directed by your teacher. You will use the magnesium and aluminum metals for the next step.
4. Add 10 mL of HCl to the remaining magnesium and aluminum samples. Record your observations and indicate the relative reactivity of each metal. Clean up your work area and dispose of the materials as directed by your teacher.

Analyze and Interpret

1. Which of the three metals was the most reactive? Which metal was the least reactive?
2. Compare the reactivities of magnesium and calcium. Does the reactivity of metals appear to increase or decrease as you read down a column in the periodic table?
3. Compare the reactivities of magnesium and aluminum. Does the reactivity of metals appear to increase or decrease as you read across a row?

Conclude and Communicate

4. Compare the Bohr-Rutherford models for magnesium, calcium, and aluminum. How might their different atomic structures explain their different reactivities?

Extend Your Inquiry and Research Skills

5. **Research** Infer the reactivities of sodium, potassium, and strontium, compared with each of their neighbours in the periodic table. Check your answers by conducting research.